The Impact of Prior Knowledge and Level of Effort on the Learning Effectiveness of Subjects Using Game-Based and Traditional Certification Tutorial System

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Abstract: Recently, a professional certificate has become an important criterion of industry employment, and the computer-based test is increasingly adopted by most of certification tutorials. Besides, along with the plentiful researches of game-based learning, a learning system has been integrated with elements of games in many researches to inspire learners' motives and interests. However, does it obtain a better effectiveness to add the elements of games to a certification tutorial? It is the issue to be explored in this research. The result of analysis of experiments indicates that more difficulty to conquer or less availability of practice will possibly lead to less willingness to use the game-based certification tutorial and also the reduction of the learning effectiveness.

Keywords: Professional certificate, computer-based test, certification tutorial, game-based learning

1. Introduction

Peng (2003) considered that professional certificates had become important criteria of industry employment, a raise, and a position promotion [13]. Along with the interests of research of computer-based tests, it was stressed by Bennett, Goodman, Hessinger, Kahn, Ligget, Marshall, and Zack (1999) that the multimedia of computers was able to stimulate the learning incentive which was not given by paper-based tests [2]. A computer-based TOEFL test was increasingly adopted by many countries. Announced by the Examination Yuan in Taiwan (2003), a computer-aided approach was adopted by the TOEFL test as well as the future planning of national examinations (Retrieved from http://www.merit-times.com.tw/NewsPage.aspx? Unid=30952). Accordingly, a lot of computer-based certification tutorials were successively implemented. Garris, Ahlers, and Driskell (2002) proposed an educational game integrating the teaching contents with elements of games in order to attract learners' involvement to achieve the goals of learning [7].

Thus, Hwang and Wang (2010) proposed a prototype of license tutoring system using joyful formative assessment [9], and Hwang, Lee, and Tseng (2012) developed an educational computer game for the certification examination of e-commerce [8]. However, does it obtain a better effectiveness to add the elements of games to a certification tutorial? Hence, this study is based on the research by Hwang, Lee, and Tseng (2012) and intended to make a further analysis of the difference of learning effectiveness between the subjects using traditional version and game-based joyful version [8]. The certification tutorial

system named “qualified road” (abbreviated as QR) proposed by Hwang et al. (2012) is composed of a traditional e-version TQR and a game-based joyful version JQR which is an educational computer game [8]. Two major axes, the prior knowledge (abbreviated as PK and carried out by the pre-test) and the level of effort (abbreviated as LOE and carried out by the experience), are adopted to divide subjects within a group. Four questions are explored in this study: (1) Is there difference of learning effectiveness between TQR and JQR with higher PK and higher LOE? (2) Is there difference of learning effectiveness between TQR and JQR with higher PK and lower LOE? (3) Is there difference of learning effectiveness between TQR and JQR with lower PK and lower LOE? (4) Is there difference of learning effectiveness between TQR and JQR with lower PK and higher LOE?

2. Literature Review

Certification Examination Tutorial

Alessi and Trollip (1985) mentioned that there were two major applications for computer-based assessments. One is to establish a repository of examination questions, and the other is to substitute a paper-based test with a stand-alone computer-based test [1]. Due to the advancement and popularity of information technologies, Devedzic (2003) indicated that web-based learning and testing have become important issues in education [6]. Yeh (2006) and Lee (2006) digitized the content of certification questions and integrated the tutor platform of a certification examination with interactive computer-based learning and testing to improve a shortage of interactivity and immediate feedback when using a paper-based approach [15, 11].

Game Based Learning

Chuang (2004) considered that the digital game-based learning got more advantages than others, because the students had a good impression on the digital game-based learning since before [3]. Deubel (2006) considered that joyful digital learning was able to retain the leaning motives of students and to achieve the goal of personalized learning [5]. Clark (2007) found that the challenge in games accompanied with the feedback was able to raise learners’ participation [4]. Tsai, Yu, and Hsiao (2008) found the learning tasks and interactivity in the digital game-based learning produced a key influence on the learning behavior and the learning effectiveness, and it also demonstrated the value of digital game-based learning in specific learning field [14].

3. Experiment Design

Experiment Tool

The Experiment tool is based on a certification tutorial named “qualified road” (abbreviated as QR) proposed by Hwang et al. (2012). When the students login in the QR, they will be distinguished into the users of TQR or JQR and then be conducted to the corresponding version. The TQR user interface is illustrated as Figure 1, and the JQR user interface is illustrated as Figure 2. Three elements are added only in JQR including “life ball”, “experience” and “abandon answering”; the life ball with initial value of 30

represents the upper bound of lost points to conquer the game; the experience is cumulative without limits and represents the level of efforts (Hwang et al., 2012) [8].

Figure 1. The TQR user interface [8]

Figure 2. The JQR user interface [8]

Experiment Implementation

The subjects are two classes of sophomores from a university of science and technology in the middle of Taiwan to be divided into a TQR group and a JQR group, respectively. The teaching content and the teacher are totally the same to all subjects. First, a pre-test is implemented to investigate the prior knowledge of subjects. The period of experiment lasts for nine weeks. Finally the post-test is implemented to assess the learning effectiveness of all subjects. The post-test is the score of subjects taking an e-commerce certification examination. The experiment implementation flowchart is illustrated as Figure 3.

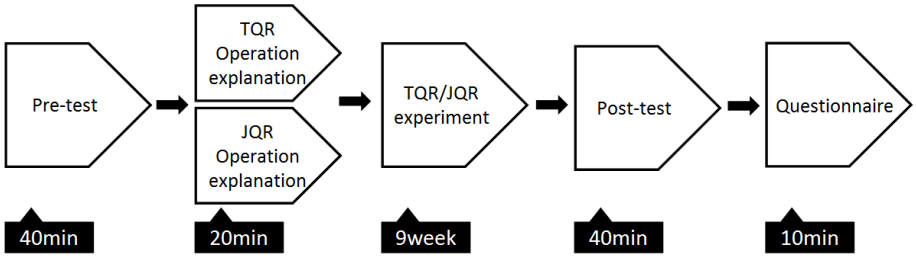

Figure 3. Experiment implementation flowchart.

Explored Question

The "prior knowledge" is represented by the "pre-test" and abbreviated as PK, and the "level of effort" is represented by the "experience" and abbreviated as LOE. First, the PK for JQR group and TQR group are sorted in descending order respectively. Fifty percentages in the front is adopted as the group of higher PK, and fifty percentages in the rear is adopted as the group of lower PK. Therefore, it generates four groups: "JQR(H-PK) group", "JQR(L-PK) group", "TQR(H-PK) group" and "TQR(L-PK) group".
The second step, the LOE for the above four groups are sorted in descending order respectively. Fifty percentages in the front is adopted as the group of higher LOE, and fifty percentages in the rear is adopted as the group of lower LOE. Consequently, eight groups are generated: "JQR(H-PK&H-LOE) group", "JQR(H-PK&L-LOE) group", "JQR(L-PK&H-LOE) group", "JQR(L-PK&L-LOE) group", "TQR(H-PK&H-LOE) group", "TQR(H-PK&L-LOE) group", "TQR(L-PK&H-LOE) group", and "TQR(L-PK&L-LOE) group". Finally, the groups with the identical nature for JQR and TQR are compared in pair. Thus, four questions mentioned above are analyzed. The classification is illustrated as Figure 4.

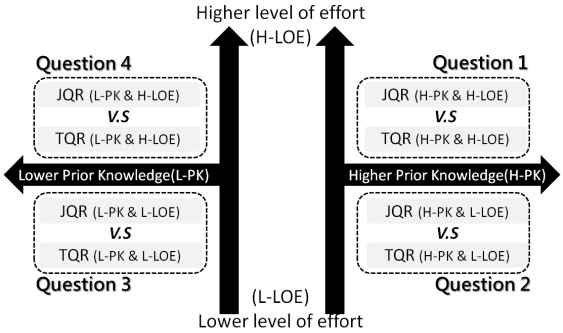

Figure 4. The classification of groups and corresponding questions

4. Experimental Analysis

Question 1: Is there difference of learning effectiveness between TQR and JQR with higher PK and higher LOE?

The pre-test and post-test of the paired groups with H-PK & H-LOE for JQR and TQR are estimated by the *t*-test. The analysis of pre-test is not significant and listed as Table 1, and the analysis of post-test is also not significant and listed as Table 2.

Table1. The *t*-test of pre-test for JQR(H-PK&H-LOE) and TQR(H-PK&H-LOE)

	Group	N	Mean	S.D.	p	*t*
Pre-test	JQR	6	37.33	3.777	.173	-2.069
	TQR	10	43.80	7.005		

Table 2. The *t*-test of post-test for JQR(H-PK&H-LOE) and TQR(H-PK&H-LOE)

	Group	N	Mean	S.D.	p	*t*
Post-test	JQR	6	76.00	12.915	.490	-1.066
	TQR	10	81.90	9.267		

Question 2: Is there difference of learning effectiveness between TQR and JQR with higher PK and lower LOE?

The pre-test and post-test of the paired groups with H-PK & L-LOE for JQR and TQR are estimated by the *t*-test. The analysis of pre-test is significant and listed as Table 3, and the analysis of post-test is not significant and listed as Table 4.

Table 3. The *t*-test of pre-test for JQR(H-PK&L-LOE) and TQR(H-PK&L-LOE)

	Group	N	Mean	S.D.	p	*t*
Pre-test	JQR	6	40.17	4.579	.005	.179*
	TQR	10	39.80	2.616		

*p<0.05

Table 4. The *t*-test of post-test for JQR(H-PK&L-LOE) and TQR(H-PK&L-LOE)

	Group	N	Mean	S.D.	p	*t*
Post-test	JQR	6	83.33	7.633	.393	.193
	TQR	10	82.70	5.498		

Question 3: Is there difference of learning effectiveness between TQR and JQR with lower PK and lower LOE?

The pre-test and post-test of the paired groups with L-PK & L-LOE for JQR and TQR are estimated by the *t*-test. The analysis of pre-test is not significant and listed as Table 5, and the analysis of post-test is also not significant and listed as Table 6. However, the mean of post-test for JQR group is 27.8 higher than the mean of post-test for TQR group. The possible reason of no significant difference between JQR and TQR is that the post-test scores of the two groups demonstrate high standard deviation. The results may suggest that game-based joyful version is better than traditional version for lazy students with lower prior knowledge.

Table 5. The *t*-test of pre-test for JQR(L-PK&L-LOE) and TQR(L-PK&L-LOE)

	Group	N	Mean	S.D.	p	*t*
Pre-test	JQR	5	27.40	4.099	.725	.213
	TQR	8	26.88	4.454		

Table 6. The *t*-test of post-test for JQR(L-PK&L-LOE) and TQR(L-PK&L-LOE)

	Group	N	Mean	S.D.	p	*t*
Post-test	JQR	5	73.80	31.108	.950	1.683
	TQR	8	46.00	27.672		

Question 4: Is there difference of learning effectiveness between TQR and JQR with lower PK and higher LOE?

The pre-test and post-test of the paired groups with L-PK & H-LOE for JQR and TQR are estimated by the *t*-test. The analysis of pre-test is not significant and listed as Table 7, and the analysis of post-test is significant and listed as Table 8. The results indicate that traditional version is better than game-based joyful version for the diligent students with lower prior knowledge.

Table 7. The *t*-test of pre-test for JQR(L-PK&H-LOE) and TQR(L-PK&H-LOE)

	Group	N	Mean	S.D.	p	*t*
Pre-test	JQR	6	27.33	3.830	.737	-1.149
	TQR	7	30.00	4.435		

Table 8. The *t*-test of post-test for JQR(L-PK&H-LOE) and TQR(L-PK&H-LOE)

	Group	N	Mean	S.D.	p	*t*
Post-test	JQR	6	73.83	16.290	.019	-1.628*
	TQR	7	84.57	6.051		

*p<0.05

5. Conclusion

According to the results, we find that no significant difference of learning effectiveness for students with higher prior knowledge no matter using TQR version or JQR version. As to students with lower prior knowledge, TQR version is better than JQR version for diligent students, but JQR version is better than TQR version for lazy students.

Some results of researches in the past also indicated no significant difference of learning effectiveness for game-based learning. Michael, Klee, Bransford, and Warren (1993) and Kuo (2007) pointed out that mostly the reason of the uncertainty of learning effectiveness for game-based learning is due to the memorized type of multiple choice questions in tests [12, 10]. The type of questions included in this adopted certification tutorial is also memorized type of multiple choice questions, and the results in this study also meet the results of the prior researches.

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